

# CLAIMS

- 1 1. An antenna comprising:  
2 a substrate having first and second opposing surfaces;  
3 a plurality of antenna elements disposed on the first surface of said substrate;  
4 a ground plane disposed on the second surface of said substrate; and  
5 at least one surface wave control structure disposed on the first surface of said substrate  
6 and between an adjacent pair of the plurality of antenna elements, where said at least one  
7 surface wave control structure has a triangular cross section in a plane perpendicular to said  
8 substrate, and an apex at a pre-determined distance above the first surface of said substrate,  
9 wherein the apex has a pre-determined apex angle.
- 1 2. The antenna of claim 1, wherein the intersection of the at least one surface wave control  
2 structure with the first surface of the substrate is a rectangle.
- 1 3. The antenna of claim 1 wherein the major axis of the at least one surface wave control  
2 structure has a pre-determined orientation angle with respect to a line connecting the centroids  
3 of the adjacent pair of the plurality of antenna elements.
- 1 4. The antenna of claim 3, wherein the orientation angle is such that the mutual coupling  
2 between the adjacent pair of antenna elements is reduced.
- 1 5. The antenna of claim 1, wherein the apex is at a distance between 0.1 and 1.0 inches  
2 above the substrate, and the apex angle is between 5 and 30 degrees.
- 1 6. The antenna of claim 1, wherein the plurality of antenna elements are stacked patch  
2 antenna elements.
- 1 7. The antenna of claim 6, wherein the plurality of antenna elements corresponds to four  
2 antenna elements disposed as a four element array, and the at least one surface wave control

3 structure corresponds to two surface wave control structures that are disposed to reduce the  
4 mutual coupling between each of the four antenna elements.

1 8. The antenna of claim 7 wherein the four element array and the two surface wave control  
2 structures correspond to an antenna sub-assembly, and the antenna comprises a plurality of the  
3 antenna sub-assemblies.

1 9. An antenna including one or more stacked patch assemblies, each having a first patch  
2 element adapted to couple with an isolation structure to a second patch element, the second  
3 patch element disposed on a first surface of a substrate, and a ground plane disposed on a  
4 second surface of the substrate, wherein the first surface of the substrate corresponds to a  
5 radiating surface, the antenna comprising:

6 one or more upper tuning structures having a first end in electrical contact with the first  
7 patch element and a second end in electrical contact with the second patch element; and

8 one or more lower tuning structures having a first end in electrical contact with the  
9 second patch element and a second end in electrical contact with the ground plane, wherein said  
10 one or more upper tuning structures and said one or more lower tuning structures are disposed  
11 such that the first and the second patch element can be tuned independently of each other.

1 10. The antenna of claim 9, wherein the upper and lower tuning structures are conductive  
2 screws.

1 11. The antenna of claim 9, wherein the upper and lower tuning structures are conductive  
2 vias.

1 12. The antenna of claim 9, wherein at least one of the upper and lower tuning structures  
2 comprises one or more respective conductive vias.

1 13. The antenna of claim 9, wherein the one or more stacked patch assemblies correspond to  
2 four stacked patch assemblies.

1        14.        The antenna of claim 13, wherein the wherein the four stacked patch assemblies  
2        corresponds to an antenna sub-assembly, and a plurality of antenna sub-assemblies comprises  
3        an antenna array.

1     16.     The antenna of claim 15, further comprising a second upper feed coupled to the first  
2     patch element, where the lower tuning structures are aligned with the second upper feed.

© 2006 The Authors  
Journal compilation © 2006 Blackwell Publishing Ltd

1     19.     The antenna of claim 9, further comprising an upper feed coupled to the first patch  
2     element, where the upper tuning structures are aligned with the upper feed.

1     21.     The antenna of claim 9, wherein the first and second patch elements are provided having  
2     one of:

- 3 a) a square shape,  
4 b) a round shape, and  
5 c) a rectangular shape.

1 22. The antenna of claim 9, further including a conductive sidewall coupled to the ground  
2 plane and disposed upon the circumference of the substrate.

1 23. The antenna of claim 9, further including one or more combiner circuits coupled to each  
2 respective one or more stacked patch assemblies to provide a pre-determined polarization.  
3 polarization.